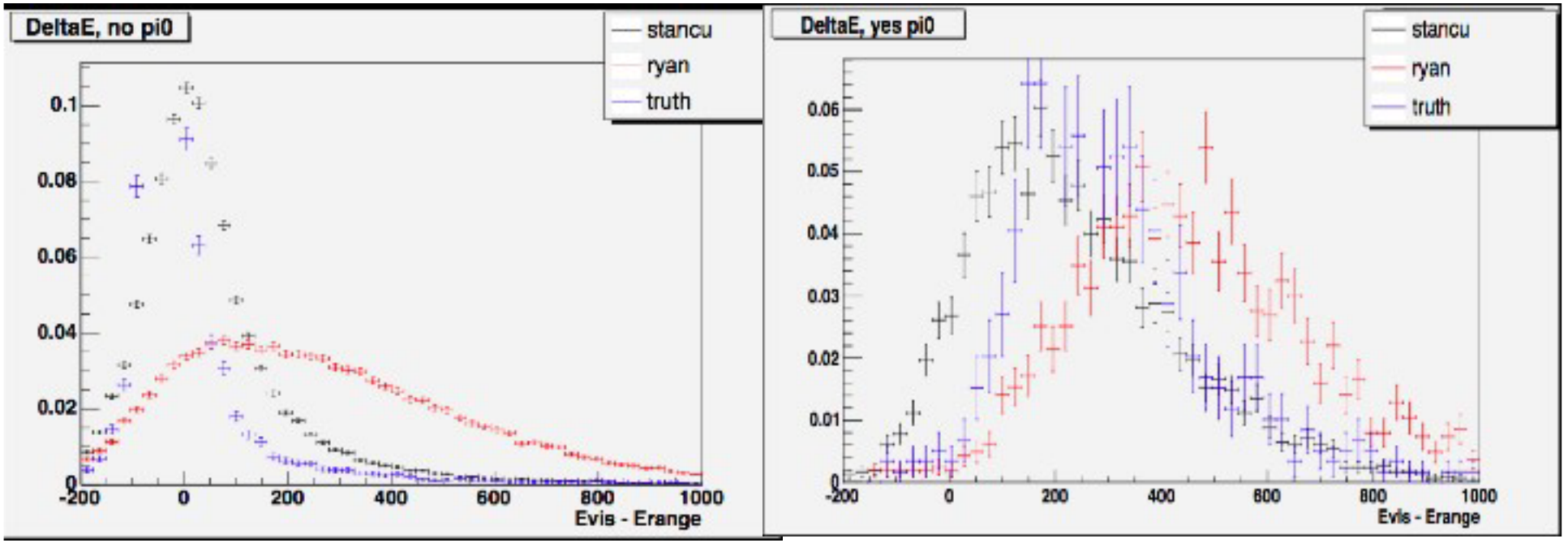
Muon track length calculation

- Three options were pursued
  - Estimated muon track length: StancuMuvd_L
  - Distance between muon and michel StancuFull vertices
  - OneTrack (Reconstruction) vertices
- These were compared to the “true” track length
  - InputMonteCarlo_VRTX and IFSP numbers

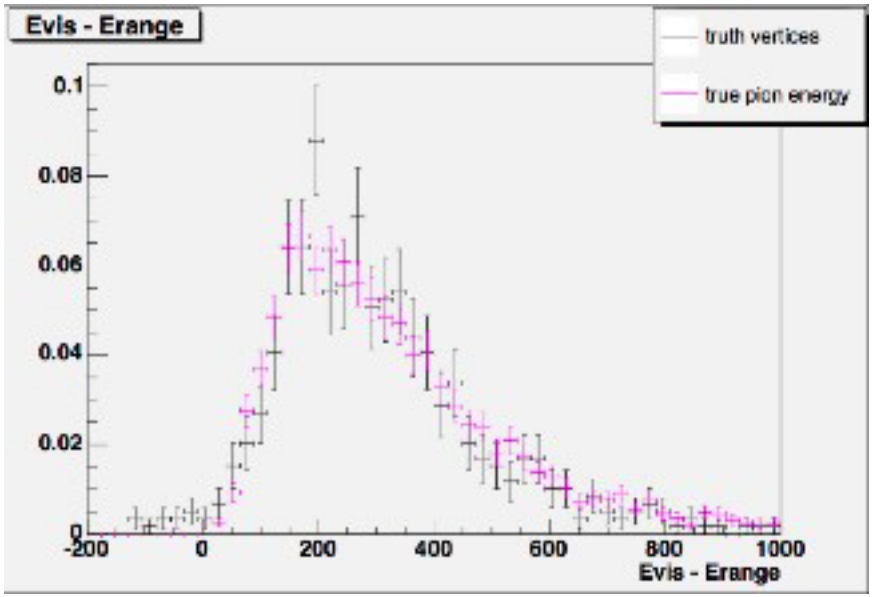
Comparison of Δ_E using different track length calculations in May06 MC.

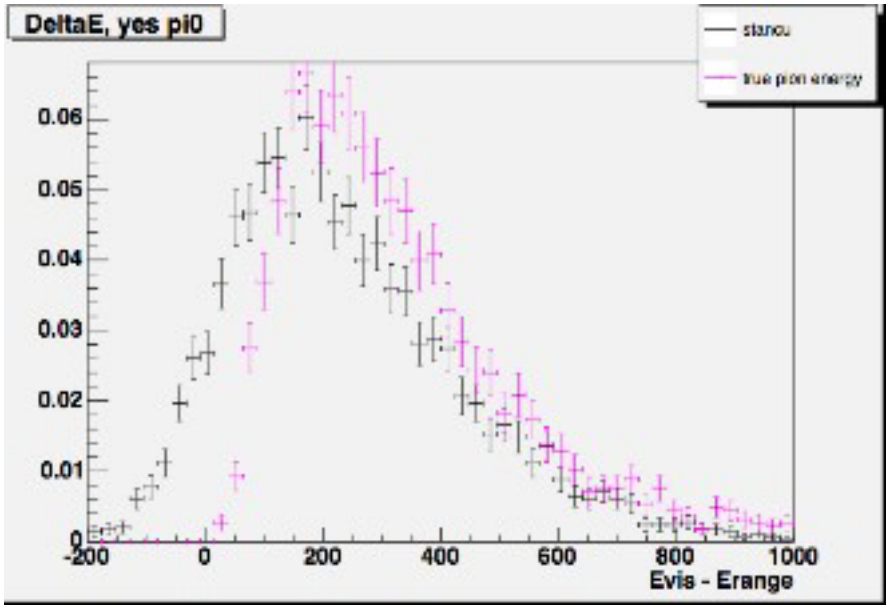
For all events



Note that portions of most distributions extend into negative values.

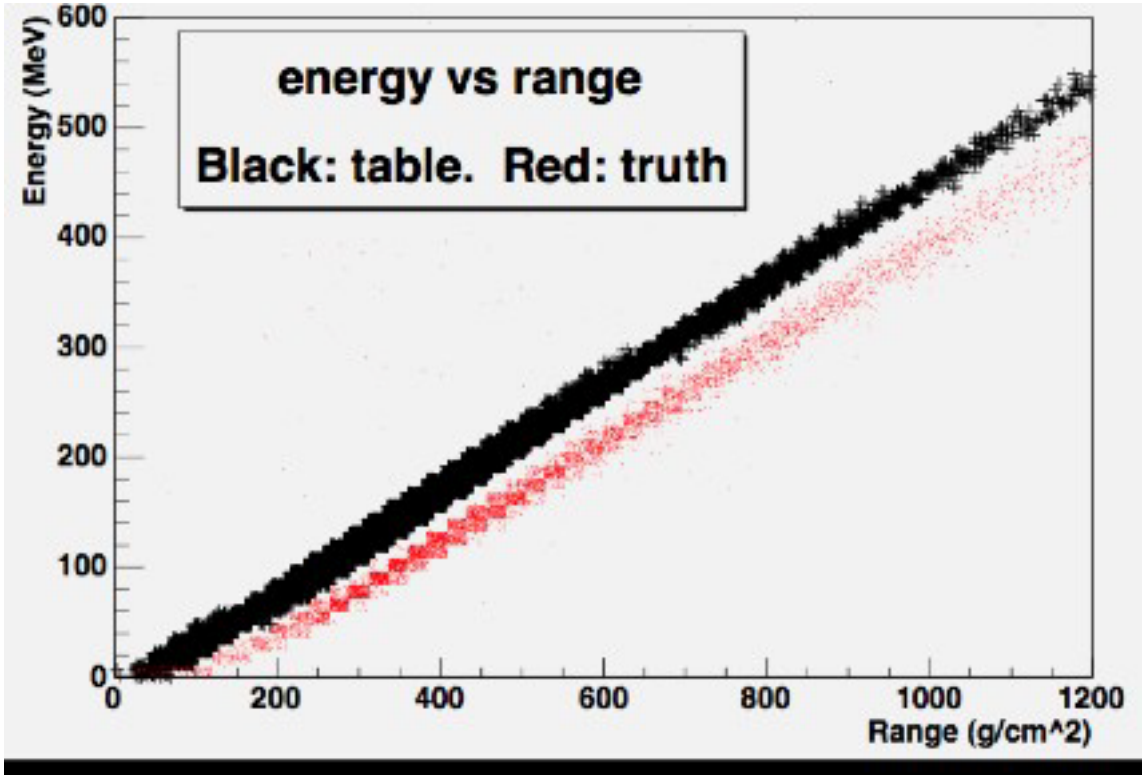
Comparison to pion energies





Note that the reconstructed curve is shifted to the left

Error in the lookup table



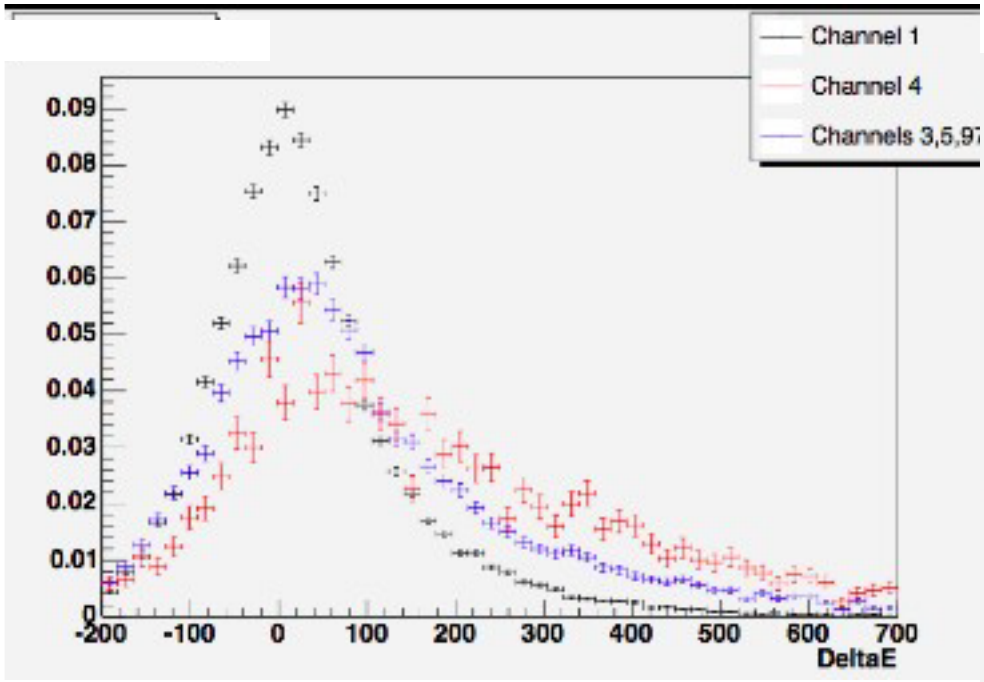
Higher value for μ^- energy means lower value for Δ_E

Why is the OneTrackChunk distribution so different?

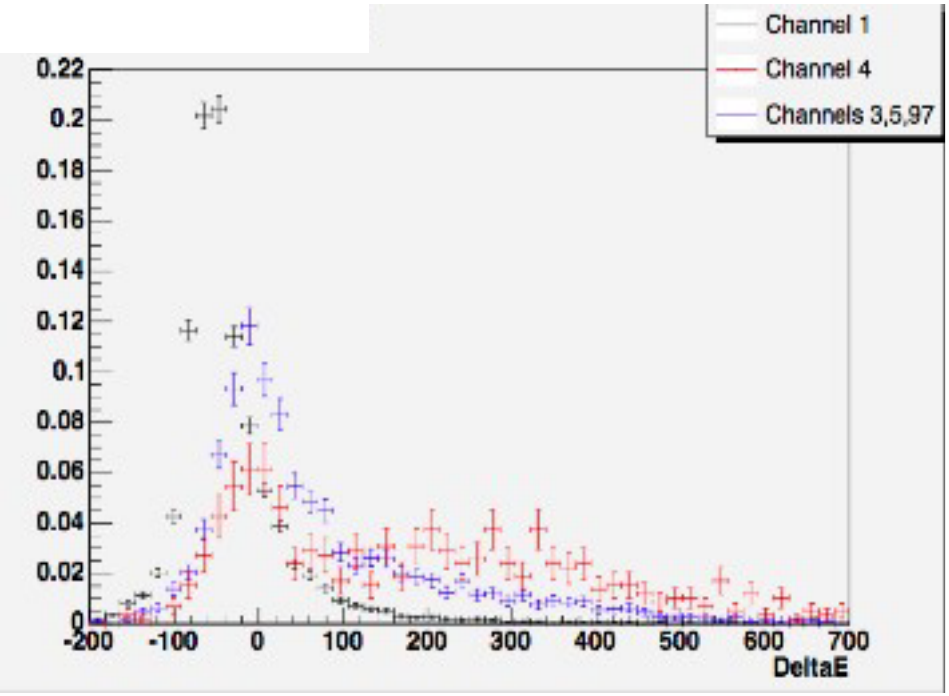
- OneTrackChunk *does* reconstruct individual vertices better than StancuFull
- However, I had difficulty ensuring that my second OneTrackChunk was the michel vertex.
- I found it much easier to proceed with Stancu, although with more time I could get the OneTrack calculation to work.

Characterization with Δ_E, by NUANCE channel

Stancu vertices



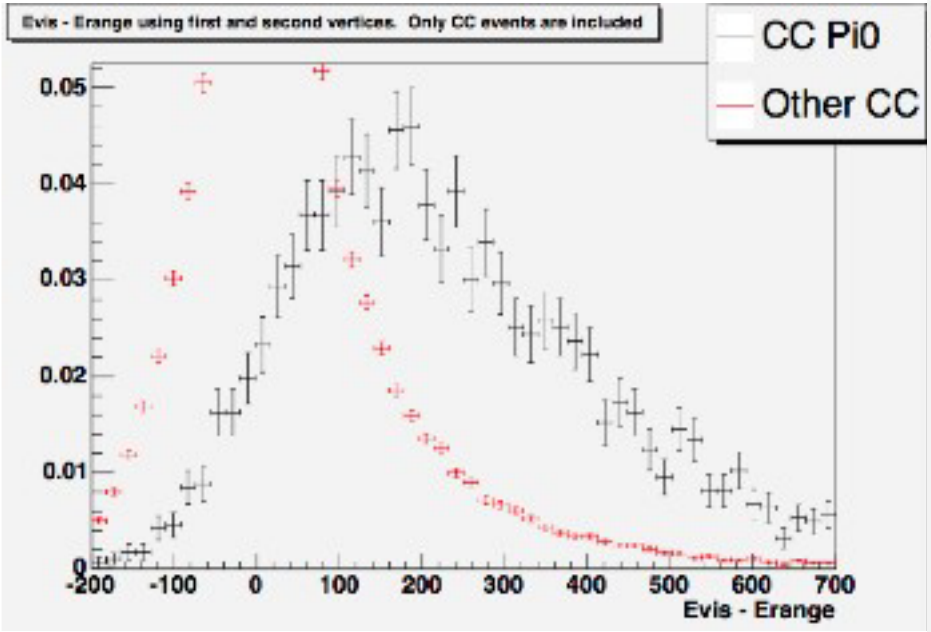
True vertices



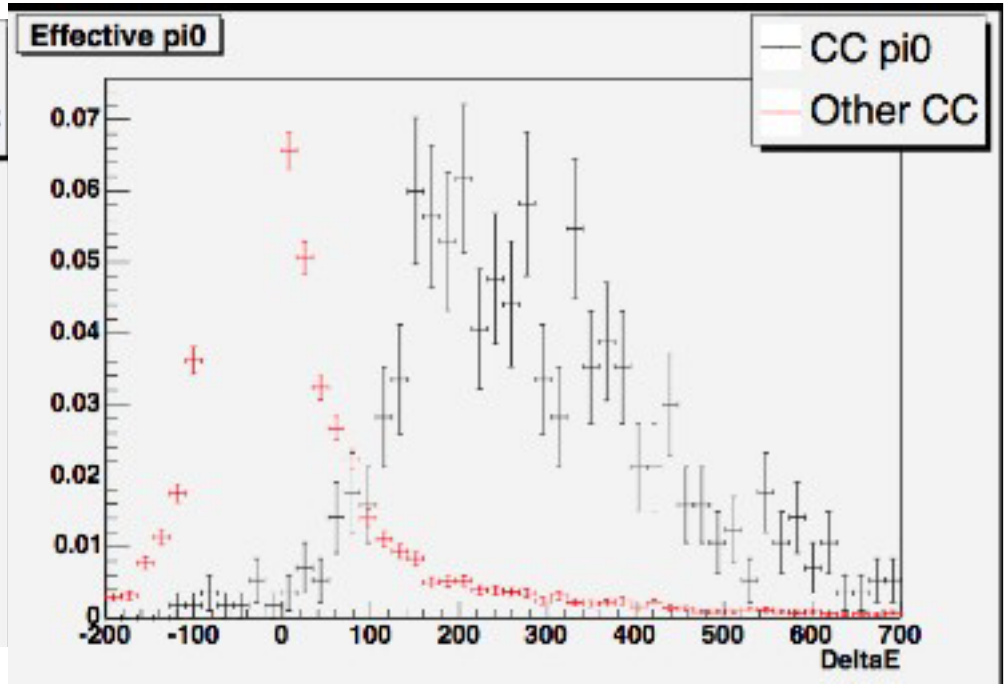
Note slight peak separations, and the two peaks for channel 1 in the “truth” graph

Characterization with Δ_E

Stancu vertices



True vertices



Much better peak separation

Filter based on NUANCE # (Statistical errors not included)

Tested on 539.6K MC events.

Cut	Efficiency	Purity
none	100.00%	3.74%
compulsory	24.42%	5.08%
2.5 < tlb45[0] < 3.5	12.29%	8.27%
fcer[0] > 0.09	9.72%	15.91%
E_mu > 2.25*TRAK + 250	6.76%	21.11%
DeltaE[0]>200	4.09%	26.13%
mass[0] > 95	3.81%	26.28%
F[0] > 4	3.62%	26.98%
CER[0] > 40	3.37%	27.64%
200 < Thits[0] < 2000	**3.37%**	**27.64%**

Laura's filter: 4.1% efficiency, 22.9% purity.

Note: individual cuts that gave high purity sometimes lowered the purity when combined with other cuts (scintillation, for example)

Filter based on effective CC π^0

Effective filter
Tested on 479.7K MC events

Cut	**Efficiency**	**Purity**
none	100.00%	3.33%
basic	25.10%	4.61%
SCI[0] > 0.3*CER[0] + 14	20.30%	19.22%
fcer[0] > 0.1	18.18%	24.19%
2.4 < tlb45[0] < 3.8	14.77%	32.76%
mass[0] > 100	12.74%	35.23%
OneTrack_E[0] > 475	11.18%	36.89%
OneTrack_F[0] > 4	10.40%	38.11%
TposHits[0] > 600	**9.54%**	**38.47%**

Antibox data vs. May06 MC

Number of MC events, nuance filter

CC QE	192
CC Pi0	620
CC Pip	686
Other	796

861 data events
(out of ~1 million)

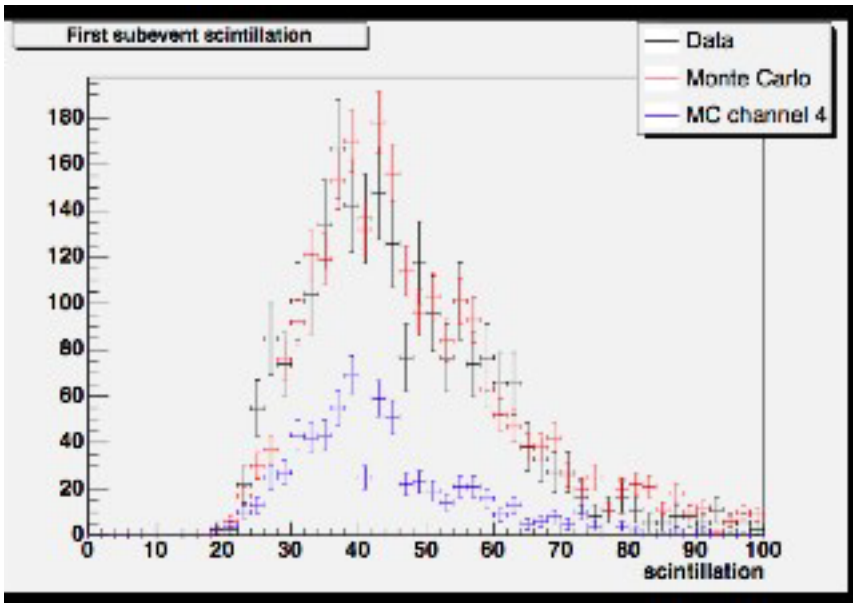
Effective filter

Pi0	1522
No pi0	2434
CC QE	546
CC Pi0	1046
CC Pip	1384
Other	942

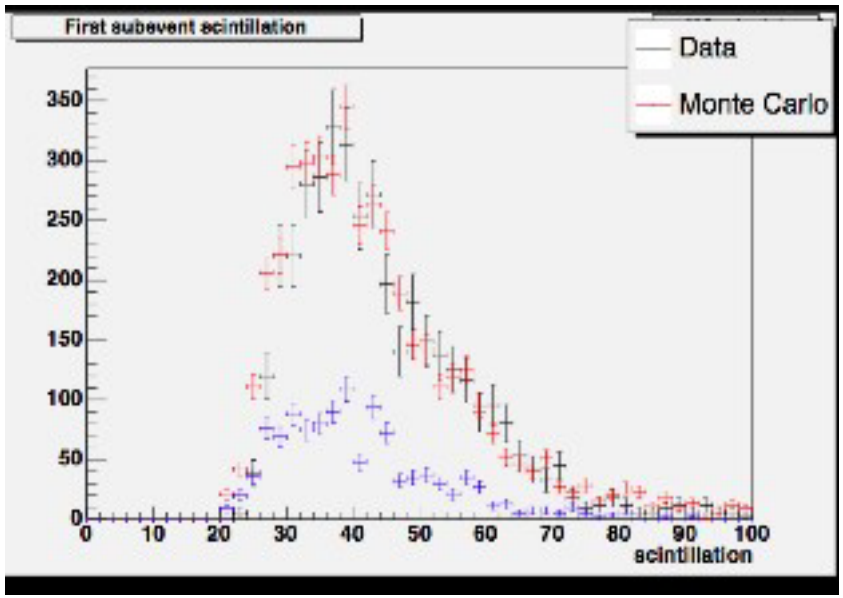
1356 data events
(out of ~1 million)

Anti-box data vs. May06 MC

Scintillation, nuance filter



Effective filter

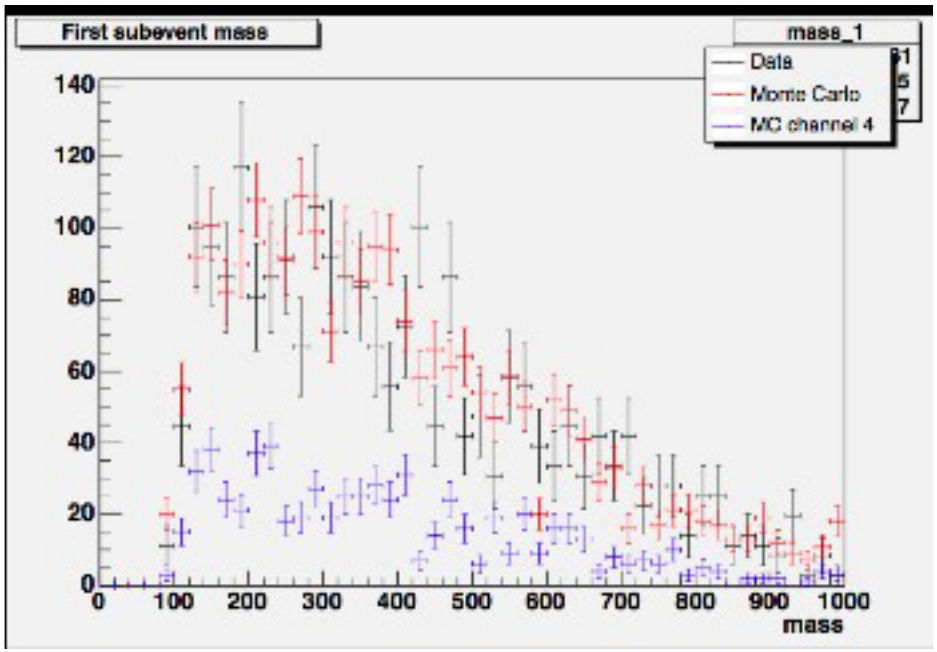


Data is normalized to MC.

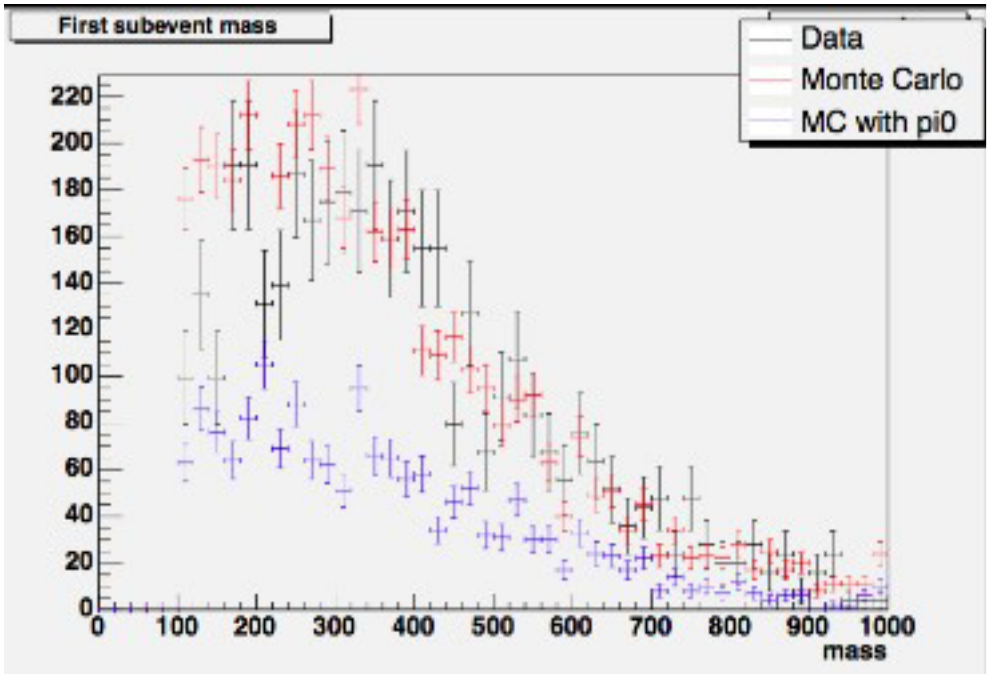
The blue distribution on the right is effective π^0s

Anti-box data vs. May06 MC

Pi0mass, nuance filter



Effective filter



Data normalized to MC

To do

- 3-ring fitter?
  - Would allow better cut on reconstructed π^0 mass
  - Could confirm the MiniBooNE resonant scattering model.
  - Failing that, incorporate P-fitter into the Δ_E calculation.
- Filter more antibox data to get higher statistics.
- Fit the filtered data to determine how many CC π^0 events are actually present.
- Cross section measurement (first a good flux measurement is needed).

Acknowledgments

- Laura J. for doing a large part of the analysis.
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